

DESCRIPTION

CLOTHES DRYER

TECHNICAL FIELD

[0001]

The present invention relates to a clothes dryer in which air is supplied into a rotary drum accommodating clothes from the outside of the clothes dryer and the air is discharged outward from the clothes dryer after moisture is taken away from the clothes so as to dry the clothes.

BACKGROUND ART

[0002]

In a case where clothes are dried in a clothes dryer or a laundry dryer, the clothes are agitated by rotating a rotary drum accommodating the clothes, and air is supplied into the rotary drum so that the air is applied to clothes. The moisture of the clothes is taken away by the supplied air, and the clothes are dried (for example, refer to PTL 1).

[0003]

FIG. 9 illustrates a sectional configuration of the clothes dryer disclosed in the related art disclosed in PTL 1. As illustrated in FIG. 9, in the clothes dryer in the related art, the clothes are loaded into rotary drum 101, and door 102 is closed. Thereafter, power is supplied to motor 103.

If the power is supplied to motor 103, rotation of motor 103 is transmitted to rotary drum 101 by drum rotating pulley 104 and drum

belt 105, and baffle 106 starts to rotate the clothes inside rotary drum 101.

[0004]

On the other hand, the rotation of motor 103 is also transmitted to fan rotating pulley 107, fan belt 108, and fan pulley 109, thereby rotating fan 110. The rotation of fan 110 causes external air to be sucked through slit-like air suction port 112 disposed on a front surface of filter storage tool 111. The sucked external air passes through filter 113 and air suction passage 114, and is heated by self-heating heater 115.

[0005]

The heated hot air is introduced into rotary drum 101 from multiple hot air suction holes 116 disposed in rotary drum 101. The heating air introduced into rotary drum 101 absorbs the moisture of the clothes while the heating air passes through the clothes. In this manner, a drying step of the clothes is performed using the heating air. After the drying step of the clothes, the hot air containing the moisture passes through a plurality of filter hot air discharge holes 118 and filter 119 disposed in filter accommodation tool 117. The hot air further passes through hot air discharge hole 120 disposed in a rear portion of rotary drum 101, and is discharged outward from the clothes dryer through hot air discharge port 122 disposed above a rear surface of outer housing 100 via air discharge passage 121.

[0006]

This step is continuously performed, thereby drying the clothes.

[0007]

However, according to the above-described configuration in the related art, when the warmed air fetched from the outside of the dryer dries the clothes and is subsequently discharged outward from the dryer,

heat is also discharged outward from the dryer at the same time. This causes a problem in that drying efficiency is lowered and an indoor environment having the clothes dryer installed therein is degraded.

[0008]

The external air is introduced into the dryer via filter 113 disposed on the front surface of outer housing 100. On the other hand, the hot air inside rotary drum 101 is discharged outward from the dryer after passing through filter 119 disposed in the rear portion of rotary drum 101. Therefore, two filters are respectively present in mutually different places. Consequently, a user has to clean each of the two places.

Citation List

Patent Literature

[0009]

PTL 1: Japanese Patent Unexamined Publication No. 53-143068

SUMMARY OF THE INVENTION

[0010]

The present invention is made in order to solve the above-described problem, and aims to provide a clothes dryer which improves drying efficiency of the clothes dryer, comfortably maintains an environment having the clothes dryer installed therein, and simultaneously improves workability of cleaning a lint filter.

[0011]

Specifically, according to an exemplary embodiment of the present invention, there is provided a clothes dryer including a main body, a rotary drum disposed inside the main body so as to be rotatable, an air suction port through which drying air is fetched, an air suction route that

supplies the drying air into the rotary drum from the air suction port, a heating unit that is disposed on the air suction route so as to heat the drying air, an air supply unit that is disposed on the air suction route so as to supply the drying air into the rotary drum, an air discharge port through which the drying air is discharged, an air discharge route that supplies the drying air which dried clothes inside the rotary drum to the air discharge port, and a control unit that controls the air supply unit and the heating unit. The clothes dryer is configured to further have a heat exchange unit that enables heat exchange of the drying air passing through the air suction route and the air discharge route.

[0012]

According to this configuration, heat wasted together with discharged air is recovered by sucked air. Accordingly, drying efficiency can be improved. The heat discharged outward from the clothes dryer is restrained. Accordingly, it is possible to minimize possibilities that an environment having the installed clothes dryer is degraded due to the waste heat.

[0013]

In the clothes dryer according to the exemplary embodiment of the present invention, the air suction port may be configured to open inward of the main body. In this manner, warmer air is sucked into the main body, and it is possible to restrain large foreign substances from entering the air suction route from the outside of the clothes dryer.

[0014]

The clothes dryer according to the exemplary embodiment of the present invention may further include a first lint filter unit for collecting foreign substances. The first lint filter unit may have a first suction unit disposed on the air suction route and a first discharge unit disposed on

the air discharge route. The first suction unit and the first discharge unit may be coupled to each other via a coupler. A first adjacent portion forming the heat exchange unit may be disposed in the coupler located between the first suction unit and the first discharge unit. According to this configuration, heat exchange is easily performed between the drying air passing through the first lint filter unit and fetched from the outside of the dryer and the drying air discharged outward from the dryer.

[0015]

In the clothes dryer according to the exemplary embodiment of the present invention, in the first air suction unit and the first discharge unit of the first lint filter unit, a first filter sheet may be disposed in at least the first discharge unit. According to this configuration, it is possible to efficiently collect lint.

[0016]

The clothes dryer according to the exemplary embodiment of the present invention may further have a second lint filter unit that is disposed on a downstream side of the first lint filter unit. The second lint filter unit may have a second suction unit disposed on the air suction route and a second discharge unit disposed on the air discharge route, and the second suction unit and the second discharge unit are coupled to each other. The second filter sheet may be disposed in each of both the second suction unit and the second discharge unit. According to this configuration, it is possible to reliably collect the foreign substances and lint which are contained in the sucked drying air, and lint contained a lot in the drying air discharged from the rotary drum after being separated from clothes.

[0017]

In the clothes dryer according to an exemplary embodiment of the

present invention, a second adjacent portion forming the heat exchange unit may be disposed on the downstream side of the first lint filter unit in the air suction route and the air discharge route, and on an upstream side from the heating unit in the air suction route. According to this configuration, the heat exchange is more reliably performed between the drying air fetched from the outside of the dryer and the drying air discharged outward from the dryer.

[0018]

The clothes dryer according to the exemplary embodiment of the present invention may further include a filter accommodation portion that accommodates the first lint filter unit so as to be detachable from the filter accommodation portion. The filter accommodation portion may be configured to have a suction port for communicating with the air suction route and a discharge port for communicating with the air discharge route.

[0019]

In the clothes dryer according to the exemplary embodiment of the present invention, the second lint filter unit may be disposed in the filter accommodation portion so as to be detachable from the filter accommodation portion.

BRIEF DESCRIPTION OF DRAWINGS

[0020]

FIG. 1 is a perspective view illustrating an external configuration of a front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention.

FIG. 2 is a plan view when an interior of the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the

present invention is viewed from above.

FIG. 3 is a view illustrating a sectional configuration taken along line 3-3 in FIG. 2 of the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention.

FIG. 4 is a horizontal sectional view when an enlarged portion of a drying route of the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention is viewed from above.

FIG. 5 is a sectional view taken along line 5-5 in FIG. 4 of the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention.

FIG. 6 is a sectional view taken along line 6-6 in FIG. 4 of the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention.

FIG. 7A is a perspective view of a first lint filter unit of the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention.

FIG. 7B is a perspective view of a second lint filter unit of the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention.

FIG. 7C is a perspective view of a cross section of a filter accommodation portion of the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention.

FIG. 8 is a graph illustrating a discharge temperature of drying air after a drying step is performed in the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention.

FIG. 9 is a view illustrating a sectional configuration of a clothes

dryer in the related art.

DESCRIPTION OF EMBODIMENT

[0021]

Hereinafter, with regard to an exemplary embodiment according to the present disclosure, an example of a front-loading type washing machine & dryer will be described with reference to the drawings.

The present disclosure is not limited to the exemplary embodiment described herein.

[0022]

(Exemplary Embodiment 1)

Exemplary Embodiment 1 illustrates a front-loading type washing machine & dryer in which a clothes dryer according to the present invention is applied to a front-loading type washing machine. FIG. 1 is a perspective view illustrating an external configuration of the front-loading type washing machine & dryer according to Exemplary Embodiment 1 of the present invention, and FIG. 2 is a plan view when an interior of the front-loading type washing machine & dryer is viewed from above. FIG. 3 is a view illustrating a sectional configuration taken along line 3-3 in FIG. 2 of the front-loading type washing machine & dryer according to Exemplary Embodiment 1, and mainly illustrates a configuration for fulfilling a drying function of front-loading type washing machine & dryer 1 according to the present exemplary embodiment. FIGS. 1 to 6 illustrate at least one of a forward direction, a rightward direction, and an upward direction which respectively correspond to the drawings.

[0023]

As illustrated in FIGS. 1 and 3, front-loading type washing

machine & dryer 1 according to Exemplary Embodiment 1 has rotary drum 2 inside washing machine housing body 6. As illustrated in FIG. 3, an opening portion (laundry loading & unloading port 11) of rotary drum 2 is disposed obliquely upward on a front surface side (front side) of washing machine housing body 6, and rotary drum 2 is configured to employ an oblique drum form. On the front surface of washing machine housing body 6, door body 9 for loading and unloading laundry into and out from rotary drum 2 is disposed so as to be openable and closeable (refer to FIGS. 1 and 3). As illustrated in FIGS. 1 to 3, operation unit 17 for a user to select and input a running operation of front-loading type washing machine & dryer 1 is disposed above door body 9. Detergent dispenser 18 for dispensing a detergent is disposed on an upper left side when viewed from the front surface of washing machine housing body 6. First lint filter unit 21 is disposed on an upper right side of washing machine housing body 6 so as to enable maintenance work after being drawn out from washing machine housing body 6. First lint filter unit 21 is disposed in top surface portion 7 of washing machine housing body 6 so as to be easily maintained by a user.

[0024]

As illustrated in FIG. 3, inside washing machine housing body 6, water tub 3 accommodating rotary drum 2 is disposed while being supported by a suspension structure such as damper 5. Rotary drum 2 is rotationally driven by motor 14 disposed behind water tub 3.

[0025]

Hereinafter, a washing operation performed by front-loading type washing machine & dryer 1 according to the present exemplary embodiment will be described.

[0026]

A user opens door body 9, loads the laundry into rotary drum 2 through laundry loading & unloading port 11, and dispenses the detergent into detergent dispenser 18. If operation unit 17 is operated by the user so that a running course is selected and input, and an instruction to start running is input, the detergent mixed water mixed with the detergent put into detergent dispenser 18 is supplied into water tub 3. If water is supplied depending on a loaded amount of the laundry, rotary drum 2 is rotationally driven. Agitating blade 4 disposed on an inner peripheral surface of rotary drum 2 lifts the laundry, and drops down the laundry from above, thereby performing a beating and washing step. If the washing step is completed, drain valve 12 is opened, and dirty washing water is discharged outward from rotary drum 2 through drain pipeline 13. After the washing step, each step for rinsing and spin-drying are performed. However, the steps are well-known operations, and thus, description thereof will be omitted.

[0027]

In front-loading type washing machine & dryer 1, in a case where operation unit 17 is operated by the user and a course including the drying step is selected as a running course, after the spin-drying step is completed, the process proceeds to the drying step for drying the laundry. In front-loading type washing machine & dryer 1, operation unit 17 is operated so as to perform only the drying step for drying wet clothes loaded into rotary drum 2, thereby enabling front-loading type washing machine & dryer 1 to be operated as the clothes dryer. That is, front-loading type washing machine & dryer 1 according to Exemplary Embodiment 1 has a drying function of the laundry as the clothes dryer. The drying function belonging to front-loading type washing machine & dryer 1 will be described below.

[0028]

FIG. 4 is a horizontal sectional view when an enlarged portion of a drying route of front-loading type washing machine & dryer 1 according to Exemplary Embodiment 1 of the present invention is viewed from above. FIG.5 is a sectional view taken along line 5-5 in FIG. 4 of the front-loading type washing machine & dryer. FIG.6 is a sectional view taken along line 6-6 in FIG. 4 of the front-loading type washing machine & dryer. FIG.7A is a perspective view of a first lint filter unit of the front-loading type washing machine & dryer. FIG.7B is a perspective view of a second lint filter unit of the front-loading type washing machine & dryer. FIG. 7C is a perspective view of a cross section of a filter accommodation portion of the front-loading type washing machine & dryer.

[0029]

As illustrated in FIGS. 2 and 3, an upper portion of washing machine housing body 6 has configuration element of drying function 8 including each configuration element illustrated in FIGS. 4 to 6 in order to fulfill the drying function belonging to front-loading type washing machine & dryer 1.

[0030]

Air suction port 23 into which the air flowing into washing machine housing body 6 from the outside of washing machine housing body 6 is fetched as the drying air of the clothes is disposed to open inward of washing machine housing body 6 (refer to FIGS. 4 and 5). Air discharge port 24 serving as an opening portion through which the drying air is discharged after the clothes are dried inside rotary drum 2 is disposed to open outward of washing machine housing body 6 (refer to FIGS. 1, 2, 4, and 6). As illustrated in FIGS. 3 to 6, a route from air

suction port 23 to air discharge port 24 is configured as function as drying route 19 of the drying air. Drying route 19 is configured to include air suction route 25, water tub 3, rotary drum 2, and air discharge route 26.

[0031]

Air suction route 25 is a route for supplying the drying air sucked from air suction port 23 into rotary drum 2 from air suction port 23 (refer to FIGS. 4 and 5). In front-loading type washing machine & dryer 1 according to the present exemplary embodiment, air suction route 25 is configured to include air suction port 23, filter accommodation portion 35, suction port 33, air suction pipeline 27, first connecting hose 29, and air supply inlet 15 disposed in water tub 3 (refer to FIG. 5).

[0032]

As illustrated in FIGS. 4 and 6, air discharge route 26 is a route for discharging the drying air from the inside of rotary drum 2 toward air discharge port 24 after the clothes are dried inside rotary drum 2. In front-loading type washing machine & dryer 1 according to the present exemplary embodiment, air discharge route 26 is configured to include air supply outlet 16 disposed in water tub 3, second connecting hose 30, filter accommodation portion 35, discharge port 34, and air discharge pipeline 28 for communicating with air discharge port 24. As illustrated in FIG. 1, air discharge port 24 has latticed cover body 24a for preventing foreign substances from entering washing machine housing body 6.

[0033]

As illustrated in FIG. 4, in front-loading type washing machine & dryer 1 according to the present exemplary embodiment, filter accommodation portion 35 is configured so that first lint filter unit 21 and second lint filter unit 22 are internally mounted thereon. Therefore,

air suction route 25 is configured to include first suction unit 21a of first lint filter unit 21, second suction unit 22a of second lint filter unit 22, and suction port 33 inside filter accommodation portion 35. Air discharge route 26 is configured to include first discharge unit 21b of first lint filter unit 21, second discharge unit 22b of second lint filter unit 22, and discharge port 34, inside filter accommodation portion 35.

[0034]

As illustrated in FIG. 7A, first lint filter unit 21 is configured so that first suction unit 21a and first discharge unit 21b are coupled to each other in parallel, and first adjacent surface (first adjacent portion) 38a is disposed in coupler 49 located between first suction unit 21a and first discharge unit 21b. In first lint filter unit 21, first filter sheet 37a is disposed in only first discharge unit 21b, and first filter sheet 37a is not disposed in first suction unit 21a.

[0035]

As illustrated in FIG. 7B, second lint filter unit 22 is configured so that second suction unit 22a and second discharge unit 22b are coupled to each other in parallel. In second lint filter unit 22, second filter sheet 37b is disposed in second suction unit 22a and second discharge unit 22b. First lint filter unit 21 and second lint filter unit 22 are respectively accommodated in filter accommodation portion 35 (refer to FIG. 7C).

[0036]

As illustrated in FIGS. 4 and 5, air suction pipeline 27 located on air suction route 25 has heater 39 serving as a heating unit, and air supply fan 20 serving as an air supply unit.

[0037]

As heater 39, a PTC heater which is relatively inexpensive and has a self-temperature control function is used.

[0038]

As air supply fan 20, a centrifugal fan is used. When the fan is used, in order to obtain a large flow rate, it is necessary to increase a rotation speed of the fan or to use a fan having a larger fan diameter. However, in a case where the rotation speed of the fan is increased, noise or vibration also increases. Therefore, in front-loading type washing machine & dryer 1 according to the present exemplary embodiment, the fan having the fan diameter of approximately 250 mm is used as air supply fan 20. Even if the noise or the vibration is generated, the rotation speed of the fan is set so as to fall within an allowable range.

[0039]

In front-loading type washing machine & dryer 1 according to the present exemplary embodiment, the drying air is sucked from air suction port 23 by rotationally driving air supply fan 20. The sucked drying air is heated by heater 39 disposed in air suction pipeline 27, and is supplied into water tub 3 from air supply inlet 15. In this manner, the heated drying air flows into rotary drum 2. The drying air flowing into rotary drum 2 comes into contact with laundry or clothes (hereinafter, collectively referred to as clothes), and takes away moisture of the clothes, thereby turning into moisturized drying air. The moisturized drying air is discharged outward of washing machine housing body 6 through air discharge port 24. In this manner, the clothes loaded into rotary drum 2 are dried.

[0040]

Motor 14, heater 39, and air supply fan 20 are controlled by a control unit (not illustrated) such as a microcontroller disposed inside washing machine housing body 6. The control unit controls front-loading type washing machine & dryer 1 in accordance with an operation

instruction input from operation unit 17.

[0041]

Next, a detailed configuration of air suction route 25 and air discharge route 26 in the above-described configuration will be described with reference to FIGS. 4 to 7C.

[0042]

On air suction route 25, air suction regulating unit 40 for regulating the drying air passing through filter accommodation portion 35 is disposed in suction port 33 serving as an inlet of air suction pipeline 27 (refer to FIGS. 4 and 5). On air discharge route 26, air discharge regulating unit 41 for regulating the drying air passing through filter accommodation portion 35 is disposed in discharge port 34 serving as an outlet to air discharge pipeline 28 (refer to FIGS. 4 and 6).

[0043]

As illustrated in FIG. 5, heater 39 is disposed on the downstream side approximately 20 mm away from air suction regulating unit 40 on air suction route 25. In an air passage of suction port 33 and an air passage at a position where heater 39 is disposed, a width in the horizontal direction is formed so that the air passage at the position where heater 39 is disposed is wider (refer to FIG. 4). In this manner, heating efficiency achieved by heater 39 is improved. In heater 39, multiple radiator plates 39a are arrayed on a surface of heater 39. In this manner, heater 39 is configured so as to increase a heat radiation area, thereby improving the heating efficiency. In general, if the heat radiation area of heater 39 is configured to increase, pressure loss of the air increases in a portion of heater 39, and a flow rate of the air flowing through the air passage decreases.

[0044]

In front-loading type washing machine & dryer 1 according to the present exemplary embodiment, as illustrated in FIG. 5, heater regulating plate 42 is used for a portion of heater 39. In this manner, the air passage is configured to be divided into first air passage 43 passing through heater 39, other air passage 44a (above first air passage 43) and another air passage 44b (below first air passage 43) which are disposed above and below first air passage 43 and directly lead to air supply fan 20 without passing through heater 39. According to this configuration, a balance is kept between maintenance of the heating efficiency achieved by heater 39 and the flow rate of the drying air.

[0045]

End portion 42a on suction port 33 side of heater regulating plate 42 is formed so as to spread in upward and downward directions toward suction port 33 side. In this manner, the air passage is configured so that the drying air easily flows into first air passage 43 and the drying air flowing into first air passage 43 uniformly passes through a portion of heater 39. Heater regulating plate 42 is configured to include a nonflammable resin. Accordingly, heater regulating plate 42 is prevented from burning caused by heat generated by heater 39.

[0046]

Lead wire 48 connected to heater 39 is configured so that a connecting portion (not illustrated) with heater 39 and a connecting portion (not illustrated) with the control unit are connected to each other. Lead wire 48 is configured to be led out from air suction pipeline 27 through the inside of other air passage 44a disposed on first air passage 43 and a through-hole (not illustrated) disposed on a top surface of air suction pipeline 27, between the connecting portion with heater 39 and the connecting portion with the control unit.

[0047]

According to this configuration, lead wire 48 is constantly cooled by chilled drying air sucked from air suction port 23. Heat conduction from cooled lead wire 48 lowers the temperature of the connecting portion where heater 39 and lead wire 48 are connected to each other. Therefore, capacity of heater 39 can be improved, and the quality of the connecting portion between heater 39 and lead wire 48 can also be ensured.

[0048]

As described above, in front-loading type washing machine & dryer 1 according to the present exemplary embodiment, air suction port 23, heater 39, and air supply fan 20 are arrayed in this order from the upstream side on air suction route 25. According to this configuration, it is possible to restrain the drying air flowing into air suction route 25 from being influenced by heat transferred and compressed by air supply fan 20. The drying air is efficiently heated while uniformly passing through a portion of heater 39. Furthermore, heater 39 causing pressure loss of the air flowing through the air passage is not disposed downstream of air supply fan 20. Accordingly, it is possible to realize a large air volume of the drying air passing through the air passage and reduced wind noise.

[0049]

Next, heat exchange of drying air between air suction route 25 and air discharge route 26 will be described.

[0050]

Inside filter accommodation portion 35 (refer to FIG. 7C), air suction route 25 and air discharge route 26 are configured to be adjacent to each other via first adjacent surface (first adjacent portion) 38a formed

in first lint filter unit 21 accommodated in filter accommodation portion 35 (refer to FIG. 7A). In each of the portion from suction port 33 to heater 39 and the portion on the downstream side of discharge port 34, air suction route 25 and air discharge route 26 are configured to be adjacent to each other via second adjacent surface (second adjacent portion) formed in filter accommodation portion 35) 38b formed in filter accommodation portion 35 (refer to FIGS. 4 and 7C). First adjacent surface 38a and second adjacent surface 38b are configured to form a heat exchange unit for heat exchange between the drying air passing through air suction route 25 and the drying air passing through air discharge route 26 (refer to FIG. 7C).

[0051]

According to the present exemplary embodiment, second adjacent surface (second adjacent portion) 38b is configured to be located on the downstream side of suction port 33 and discharge port 34 of filter accommodation portion 35. However, second adjacent surface (second adjacent portion) 38b may be configured to be located on the upstream side of suction port 33 and discharge port 34 as long as second adjacent surface 38b is located on the downstream side of first lint filter unit 21. Furthermore, second adjacent surface (second adjacent portion) 38b may be configured to include a member different from a member configuring filter accommodation portion 35, and may not be configured to include filter accommodation portion 35.

[0052]

According to the present exemplary embodiment, as illustrated in FIG. 7A, first adjacent surface 38a is formed using first lint filter unit 21 detachably mounted on filter accommodation portion 35. An adjacent surface may be formed in filter accommodation portion 35 on the

upstream side of first lint filter unit 21.

[0053]

An adjacent distance representing a distances between air suction route 25 and air discharge route 26 in a portion of first adjacent surface 38a and second adjacent surface 38b is a distance in which the air passing through air suction route 25 and air discharge route 26 respectively move close to each other to such an extent that mutual heat exchange is available.

According to the present exemplary embodiment, the adjacent distance, that is, the thickness of the portion of first adjacent surface 38a and second adjacent surface 38b is configured to be approximately 1 to 2 mm. However, the distance may be optionally determined as long as the mutual heat exchange is available between the air passing through air suction route 25 and air discharge route 26. The heat exchange unit is not limited to those which have a substantially single planar shape, and may be formed using a plurality of surfaces or a curved surface.

[0054]

Next, a filter configuration of front-loading type washing machine & dryer 1 according to the present exemplary embodiment will be described with reference to FIGS. 1 and 5 to 7C.

[0055]

As illustrated in FIGS. 1, 5 and 6, first lint filter unit 21 and second lint filter unit 22 are drawn outward of washing machine housing body 6 from top surface portion 7 of washing machine housing body 6. In this manner, both of these are configured so as to facilitate maintenance such as filter cleaning. As illustrated in FIGS. 1 and 7A, in first lint filter unit 21, decorative plate 45 is configured to flush with an outer surface of top surface portion 7 of washing machine housing body 6. A

center portion of decorative plate 45 has pivoting panel 46 configured so that the surface of decorative plate 45 is flush with the surface of decorative plate 45. If an upper portion of pivoting panel 46 is lightly pressed with a finger, pivoting panel 46 biased by a spring pivots around a pivoting axis (not illustrated) located below pivoting panel 46. In this manner, the finger can be inserted into a lower portion of decorative plate 45. If decorative plate 45 is pulled up with a fingertip, first lint filter unit 21 is drawn out from washing machine housing body 6.

[0056]

As illustrated in FIG. 7B, projection portion 22c and two claw portions 22d projecting toward a rear side are disposed on an upper portion of second lint filter unit 22. Projection portion 22e is disposed in a lower portion of second lint filter unit 22. In second lint filter unit 22, projection portion 22e is fitted into a recess disposed in a bottom portion of filter accommodation portion 35, and claw portion 22d is fitted to filter accommodation portion 35, thereby fixing and attaching second lint filter unit 22 to filter accommodation portion 35 on a rear surface side of first lint filter unit 21. If projection portion 22c is drawn forward in a state where first lint filter unit 21 is drawn outward, claw portion 22d in the upper portion of second lint filter unit 22 and filter accommodation portion 35 are disengaged from each other. In this state, second lint filter unit 22 is lifted upward so that second lint filter unit 22 is drawn outward from washing machine housing body 6.

[0057]

In first lint filter unit 21, packing member 47 is disposed around the lower portion of decorative plate 45, thereby adopting a configuration in which the drying air does not leak outward of washing machine housing body 6 from an outer periphery of decorative plate 45 (refer to

FIG. 7A).

[0058]

Next, air suction port 23 serving as an inlet of air suction route 25 will be described. Air suction port 23 is disposed in the upper portion inside washing machine housing body 6, and is configured to open inward of washing machine housing body 6 (refer to FIGS. 2 and 5). As the drying air, the air flowing into the dryer through a gap mainly including a lower portion of washing machine housing body 6 is sucked into air suction route 25 from air suction port 23. Air suction port 23 is disposed in the upper portion inside washing machine housing body 6. In this manner, the warmer air present in the upper portion inside washing machine housing body 6 can be sucked, and large foreign substances are restrained from entering washing machine housing body 6 from outside.

[0059]

If air supply fan 20 is operated, the air inside washing machine housing body 6 is sucked into air suction route 25 from air suction port 23, as the drying air. The sucked drying air is supplied into rotary drum 2 after passing through air suction route 25, that is, first suction unit 21a of first lint filter unit 21, second suction unit 22a of second lint filter unit 22, air suction regulating unit 40, heater 39, air suction pipeline 27, air supply fan 20, first connecting hose 29, and air supply inlet 15 (refer to FIG. 5).

[0060]

The drying air supplied into rotary drum 2 takes away the moisture from the clothes, and dries the clothes. Thereafter, the drying air is discharged outward of washing machine housing body 6 from air discharge port 24 after passing through air discharge route 26, that is, air supply outlet 16, second connecting hose 30, first discharge unit 21b

of first lint filter unit 21, second discharge unit 22b of second lint filter unit 22, and air discharge regulating unit 41 (refer to FIG. 6).

[0061]

Next, details of first lint filter unit 21 and second lint filter unit 22 will be described.

[0062]

As illustrated in FIG. 7A, both first suction unit 21a and first discharge unit 21b of first lint filter unit 21 are configured to respectively have latticed opening portions. First filter sheet 37a is attached to only the opening portion of first discharge unit 21b in first suction unit 21a and first discharge unit 21b of first lint filter unit 21.

[0063]

As illustrated in FIG. 7B, both second suction unit 22a and second discharge unit 22b of second lint filter unit 22 are configured to respectively have latticed opening portions. Second filter sheet 37b is attached to the opening portion of second suction unit 22a and second discharge unit 22b.

[0064]

Air suction route 25 is configured as follows. The foreign substances contained in the drying air sucked from the inside of washing machine housing body 6 are comparatively small. Accordingly, in view of cost, the foreign substances are collected by second filter sheet 37b attached to second suction unit 22a of second lint filter unit 22. On the other hand, air discharge route 26 is configured as follows. The drying air after drying the clothes passes through air discharge route 26. Accordingly, the foreign substances such as lint are contained a lot in air discharge route 26. Therefore, the foreign substances are collected by first filter sheet 37a and second filter sheet 37b which are respectively

attached to both first discharge unit 21b and second discharge unit 22b.

[0065]

In the present exemplary embodiment, air suction route 25 is configured so that the foreign substances are collected by only second filter sheet 37b attached to second suction unit 22a of second lint filter unit 22. However, first suction unit 21a of first lint filter unit 21 may have first filter sheet 37a so that foreign substances are collected by first filter sheet 37a and second filter sheet 37b. That is, in first lint filter unit 21, first filter sheet 37a may be disposed in at least first discharge unit 21b.

[0066]

In first lint filter unit 21, first suction unit 21a and first discharge unit 21b are disposed so as to be respectively located on the downstream side of air suction port 23 and the upstream side of discharge port 34. First suction unit 21a and first discharge unit 21b are couple to each other via first adjacent surface 38a.

[0067]

According to the present exemplary embodiment, as illustrated in FIG. 7A, first lint filter unit 21 is configured to include a half shell-shaped container. In view of workability, strength, and convenient handling, this container is configured to include a polypropylene material, but may be configured to include other materials. On a side surface and a bottom portion of the half shell-shaped container, an opening portion is configured to be formed in a lattice shape using a plurality of openings. In this manner, the strength of the container is ensured, and a wide opening surface for collecting the lint is secured.

[0068]

The bottom portion of first lint filter unit 21 is configured to

include the bottom portion of first discharge unit 21b and the bottom portion of first suction unit 21a. The bottom portion of first discharge unit 21b has a tilting portion tilting with respect to the surface of decorative plate 45 located above first lint filter unit 21. A step is disposed between the bottom portion of first discharge unit 21b and the bottom portion of first suction unit 21a. The tilting portion and the step of the bottom portion of first lint filter unit 21 are configured so that a shape of the bottom portion of first lint filter unit 21 matches a shape of the bottom portion of filter accommodation portion 35.

In this manner, first lint filter unit 21 is efficiently installed within a limited space inside washing machine housing body 6. Accordingly, even if first lint filter unit 21 is installed in the same space, it is possible to configure a filter having a wider opening area.

[0069]

According to the present exemplary embodiment, first filter sheet 37a or second filter sheet 37b is attached by means of insert molding to first discharge unit 21b of first lint filter unit 21, second suction unit 22a of second lint filter unit 22, and an inner surface of the opening portion formed in a lattice shape of second discharge unit 22b, that is, on an upstream side surface of air suction route 25 and air discharge route 26. In this manner, there is no projecting object such as the lattice shape on the surface (upstream side surface) on the surface for collecting the lint in first filter sheet 37a and second filter sheet 37b. Accordingly, the lint is easily removed when a user carries out maintenance work.

[0070]

As illustrated in FIG. 7C, in filter accommodation portion 35, filter replacement port 36 serving as an opening through which first lint filter unit 21 and second lint filter unit 22 are replaced is disposed in an upper

portion of filter accommodation portion 35.

[0071]

Filter accommodation portion 35 is configured so that suction port 33 serving as a portion of air suction route 25 and discharge port 34 serving as a portion of air discharge route 26 are adjacent to each other. In filter accommodation portion 35, second adjacent surface 38b is formed on the downstream side of suction port 33 and discharge port 34.

[0072]

First adjacent surface 38a formed in first lint filter unit 21 and second adjacent surface 38b formed in filter accommodation portion 35 have a heat exchange unit formed so as to enable heat exchange of the drying air between air suction route 25 and air discharge route 26. According to this configuration, the heat exchange is allowed between the air sucked from air suction port 23 and the air discharged from air supply outlet 16. That is, the drying air sucked from air suction port 23 is warmed up while flowing from air suction port 23 to heater 39. On the other hand, the drying air flowing in air discharge route 26 is cooled. Accordingly, the discharge temperature of the drying air discharged from air discharge port 24 is lowered.

[0073]

According to the present exemplary embodiment, first adjacent surface 38a formed as the heat exchange unit is configured to include a polypropylene material. Accordingly, first adjacent surface 38a can be manufactured integrally with first lint filter unit 21. In this manner, the manufacturing is facilitated, and the cost reduction is realized. As a matter of course, first adjacent surface 38a and second adjacent surface 38b may be configured to include a steel material having satisfactory heat exchange efficiency.

[0074]

As illustrated in FIG. 7A, first adjacent surface 38a formed in first lint filter unit 21 is disposed so as to tilt with respect to each air supply direction of air suction route 25 and air discharge route 26. First adjacent surface 38a is configured in this way, thereby changing a flow direction of the drying air passing through air suction route 25 and air discharge route 26 is changed, and increasing a contact area where the drying air passing through air suction route 25 and air discharge route 26 comes into contact with first adjacent surface 38a. Therefore, the more efficient heat exchange is allowed between the drying air respectively passing through air suction route 25 and air discharge route 26.

[0075]

If first lint filter unit 21 is inserted into filter accommodation portion 35, filter replacement port 36 is sealed with packing member 47 disposed in first lint filter unit 21. First lint filter unit 21 is reliably fixed to filter accommodation portion 35 by a projection-shaped portion formed on a side surface of packing member 47 so as to close filter replacement port 36.

[0076]

According to the present exemplary embodiment, heater 39 is disposed approximately 20 mm on the downstream side away from suction port 33. Air suction regulating unit 40 is disposed on the downstream side of suction port 33. Therefore, even when first lint filter unit 21 and second lint filter unit 22 are taken out from filter accommodation portion 35, heater 39 is not exposed, thereby preventing a user from erroneously touching heater 39.

[0077]

Next, a drying step in front-loading type washing machine & dryer 1 according to the present exemplary embodiment will be described with reference to FIG. 8.

[0078]

FIG. 8 is a graph illustrating the discharge temperature of the drying air after the drying step is performed in front-loading type washing machine & dryer 1 according to the present exemplary embodiment.

[0079]

FIG. 8 illustrates measurement results of the discharge temperature of the drying air under a condition that the indoor temperature is 20°C and the indoor humidity is 60%. As heater 39, the PTC heater is used as described above. An output of heater 39 is changed to 200 W, 400 W, and 600 W. The operation of air supply fan 20 is controlled, thereby changing the air volume between 0.5 m³/min and 4.0 m³/min at an interval of 0.5 m³/min. FIG. 8 illustrates measurement results of the discharge temperature of the drying air discharged outward from the dryer through air discharge port 24 under the above-described condition.

[0080]

As illustrated in FIG. 8, in any output of the heater, the discharge temperature is lowered as the air volume increases. In any air volume, the discharge temperature is lowered as the output of the heater decreases. A difference in the discharge temperatures which is caused by a difference in the outputs of the heater decreases as the air volume increases.

[0081]

Here, the following fact is empirically known well. As a result of

the drying step, if the indoor temperature becomes higher than the indoor temperature +20 degrees (°C, the same in the following) before the drying step is performed, a user feels uncomfortable with the indoor environment. That is, it is preferable that the discharge temperature is the indoor temperature +20 degrees or lower, and is more preferable that the discharge temperature is the indoor temperature +10 degrees or lower.

[0082]

In order to suppress the discharge temperature to the above-described temperature, it is desirable that the output of heater 39 is as low as possible. However, if the output of heater 39 is too low, the clothes are not readily dried, and the drying step takes a long time. On the other hand, if the output of heater 39 is too high, the discharge temperature is too high as in a case of 600 W in FIG. 8. If the temperature of the drying air coming into contact with the clothes is too high, the high temperature causes shrinkage or damage to the clothes. Therefore, the optimum output of heater 39 is approximately 400 W, and it is preferable that the output is set to 500 W at the most, that is, 500 W or lower.

[0083]

Next, the air volume in a case where the output of heater 39 is set to 500 W or lower, preferably set to 400 W will be examined. As described above, in order to suppress the discharge temperature to the indoor temperature +20 degrees or lower, more preferably to the indoor temperature +10 degrees or lower, it is desirable that the air volume of air supply fan 20 is set to 2 m³/min or more, based on FIG. 8. In this manner, the rise of the indoor temperature is suppressed to 20 degrees or lower. Due to the large amount of the drying air supplied by air supply fan 20, wrinkles of the clothes are smoothed out, and the clothes can be

dried.

[0084]

Even if the air volume is set too high, as illustrated in FIG. 8, the effect is in a saturated state. Accordingly, the air volume of air supply fan 20 is preferably 3 m³/min.

[0085]

In the above description, the condition of the output of heater 39 and the air volume of air supply fan 20 is examined so that the discharge temperature is set to the indoor temperature +20 degrees or lower, and more preferably the indoor temperature +10 degrees or lower. Instead of the above-described discharge temperature, the same effect can be obtained, even if the output of heater 39 and the air volume of air supply fan 20 are set so that the temperature of drying air coming into contact with the clothes after the drying air passes through heater 39 is the indoor temperature +20 degrees or lower, and more preferably the indoor temperature +10 degrees or lower.

[0086]

Hereinafter, the drying step in front-loading type washing machine & dryer 1 set as described above will be described.

[0087]

As air supply fan 20 is rotationally driven, the drying air is first sucked from air suction port 23. The sucked drying air passes through first air passage 43 leading to heater 39 disposed in air suction pipeline 27 and other air passages 44a and 44b directly leading to air supply fan 20 without leading to heater 39. In this case, only the drying air passing through first air passage 43 is heated by heater 39. Thereafter, the heated drying air and unheated drying air passing through other air passages 44a and 44b are mixed with each other, and are supplied into

water tub 3 from air supply inlet 15. As described above, the output of heater 39 in this case is 500 W or lower, and preferably 400 W. The air volume is 2 m³/min or more, and preferably 3 m³/min.

[0088]

As drying air passes through heater 39, the pressure loss increases in a portion of heater 39, and the flow rate decreases. However, in front-loading type washing machine & dryer 1 according to the present exemplary embodiment, the air passage in a portion of heater 39 of air suction route 25 is divided into first air passage 43 and other air passages 44a and 44b. Accordingly, a balance is kept between maintenance of the heating efficiency achieved by heater 39 and the flow rate of the drying air.

Therefore, the drying air can maintain the large air volume.

[0089]

After passing through first air passage 43 formed in a portion of heater 39 and other air passages 44a and 44b, both the drying air are mixed with each other. Thereafter, the drying air flows into rotary drum 2 rotationally driven by motor 14. The drying air comes into contact with the clothes rotating inside rotary drum 2, and takes away the moisture of the clothes, thereby turning into moisturized drying air. The moisturized drying air is discharged outward of the dryer through air discharge port 24.

In this manner, the clothes loaded into rotary drum 2 are progressively dried. As described above, the discharge temperature in this case is designed to be the room temperature +20 degrees or lower, and more preferably the room temperature +10 degrees or lower.

[0090]

The output of heater 39 configured to include the PTC heater is set

to 500 W or lower. Accordingly, the temperature inside rotary drum 2 rises less, thereby suppressing shrinkage and damage to the clothes. Furthermore, air supply fan 20 has the large air volume of 2 m³/min or more. Accordingly, the clothes can be dried while wrinkles of the clothes are smoothed out. The discharge temperature of the drying air discharged outward from the dryer is set to be the indoor temperature +20 degrees or lower. Accordingly, the temperature rises less in the room where front-loading type washing machine & dryer 1 is displaced, thereby preventing dew condensation in the room. Therefore, the environment where front-loading type washing machine & dryer 1 is installed is kept comfortable.

INDUSTRIAL APPLICABILITY

[0091]

As described above, according to the present invention, an air suction route and an air discharge route are disposed adjacent to each other. Therefore, heat exchange is facilitated between drying air respectively passing through the air suction route and the air discharge route. Therefore, since the sucked drying air is efficiently heated, it is possible to realize a large air volume of the drying air and reduce wind noise of an air supply fan. Heat is restrained from being discharged outward from a dryer. Accordingly, it is possible to minimize possibilities that an environment having the installed dryer may be degraded due to the discharged heat. Therefore, the present invention is widely applicable to a clothes dryer and a front-loading type laundry dryer.

REFERENCE MARKS IN THE DRAWINGS

[0092]

- 1 FRONT-LOADING TYPE WASHING MACHINE & DRYER
- 2 ROTARY DRUM
- 3 WATER TUB
- 4 AGITATING BLADE
- 5 DAMPER
- 6 WASHING MACHINE HOUSING BODY
- 7 TOP SURFACE PORTION
- 8 CONFIGURATION ELEMENT OF DRYING FUNCTION
- 9 DOOR BODY
- 11 LAUNDRY LOADING & UNLOADING PORT
- 12 DRAIN VALVE
- 13 DRAIN PIPELINE
- 14 MOTOR
- 15 AIR SUPPLY INLET
- 16 AIR SUPPLY OUTLET
- 17 OPERATION UNIT
- 18 DETERGENT DISPENSER
- 19 DRYING ROUTE
- 20 AIR SUPPLY FAN (AIR SUPPLY UNIT)
- 21 FIRST LINT FILTER UNIT
- 21a FIRST SUCTION UNIT
- 21b FIRST DISCHARGE UNIT
- 22 SECOND LINT FILTER UNIT
- 22a SECOND SUCTION UNIT
- 22b SECOND DISCHARGE UNIT
- 22c, 22e PROJECTION PORTION
- 22d CLAW PORTION
- 23 AIR SUCTION PORT

- 24 AIR DISCHARGE PORT
- 24a LATTICED COVER BODY
- 25 AIR SUCTION ROUTE
- 26 AIR DISCHARGE ROUTE
- 27 AIR SUCTION PIPELINE
- 28 AIR DISCHARGE PIPELINE
- 29 FIRST CONNECTING HOSE
- 30 SECOND CONNECTING HOSE
- 33 SUCTION PORT
- 34 DISCHARGE PORT
- 35 FILTER ACCOMMODATION PORTION
- 36 FILTER REPLACEMENT PORT
- 37a FIRST FILTER SHEET
- 37b SECOND FILTER SHEET
- 38a FIRST ADJACENT SURFACE (FIRST ADJACENT
PORTION)
- 38b SECOND ADJACENT SURFACE (SECOND ADJACENT
PORTION)
- 39 HEATER (HEATING UNIT)
- 39a RADIATOR PLATE
- 40 AIR SUCTION REGULATING UNIT
- 41 AIR DISCHARGE REGULATING UNIT
- 42 HEATER REGULATING PLATE
- 43 FIRST AIR PASSAGE
- 44a, 44b OTHER AIR PASSAGE
- 45 DECORATIVE PLATE
- 46 PIVOTING PANEL
- 47 PACKING MEMBER

48	LEAD WIRE
49	COUPLER
100	OUTER HOUSING
101	ROTARY DRUM
102	DOOR
103	MOTOR
104	DRUM ROTATING PULLEY
105	DRUM BELT
106	BAFFLE
107	FAN ROTATING PULLEY
108	FAN BELT
109	FAN PULLEY
110	FAN
111	FILTER STORAGE TOOL
112	AIR SUCTION PORT
113	FILTER
114	AIR SUCTION PASSAGE
115	SELF-HEATING HEATER
116	HOT AIR SUCTION HOLE
117	FILTER ACCOMMODATION TOOL
118	FILTER HOT AIR DISCHARGE HOLE
119	FILTER
120	HOT AIR DISCHARGE HOLE
121	AIR DISCHARGE PASSAGE
122	HOT AIR DISCHARGE PORT

CLAIMS

1. A clothes dryer comprising:
 - a main body;
 - a rotary drum disposed inside the main body so as to be rotatable;
 - an air suction port through which drying air is fetched;
 - an air suction route that supplies the drying air into the rotary drum from the air suction port;
 - a heating unit that is disposed on the air suction route so as to heat the drying air;
 - an air supply unit that is disposed on the air suction route so as to supply the drying air into the rotary drum;
 - an air discharge port through which the drying air is discharged;
 - an air discharge route that supplies the drying air which dried clothes inside the rotary drum to the air discharge port; and
 - a control unit that controls the air supply unit and the heating unit,wherein the clothes dryer has a heat exchange unit that enables heat exchange of the drying air passing through the air suction route and the air discharge route.
2. The clothes dryer of Claim 1,
 - wherein the air suction port opens inward of the main body.
3. The clothes dryer of Claim 1 or 2, further comprising:
 - a first lint filter unit that collects foreign substances,
 - wherein the first lint filter unit has a first suction unit disposed on the air suction route and a first discharge unit disposed on the air discharge route,
 - wherein the first suction unit and the first discharge unit are coupled to each other via a coupler, and
 - wherein a first adjacent portion forming the heat exchange unit is disposed in the coupler located between the first suction unit and the first

discharge unit.

4. The clothes dryer of Claim 3,

wherein in the first lint filter unit, a first filter sheet is disposed in at least the first discharge unit.

5. The clothes dryer of Claim 3 or 4, further comprising:

a second lint filter unit that is disposed on a downstream side of the first lint filter unit,

wherein the second lint filter unit has a second suction unit disposed on the air suction route and a second discharge unit disposed on the air discharge route, and the second suction unit and the second discharge unit are coupled to each other, and

wherein the second filter sheet is disposed in each of both the second suction unit and the second discharge unit.

6. The clothes dryer of any one of Claims 3 to 5,

wherein a second adjacent portion forming the heat exchange unit is disposed on the downstream side of the first lint filter unit in the air suction route and the air discharge route, and on an upstream side from the heating unit in the air suction route.

7. The clothes dryer of any one of Claims 3 to 6, further comprising:

a filter accommodation portion that accommodates the first lint filter unit so as to be detachable from the filter accommodation portion,

wherein the filter accommodation portion has a suction port for communicating with the air suction route and a discharge port for communicating with the air discharge route.

8. The clothes dryer of Claim 7,

wherein the second lint filter unit is disposed in the filter accommodation

portion so as to be detachable from the filter accommodation portion.